Table 5. Spider mite control on corn with Comite® applied through the Low Energy Precision Application (LEPA) center pivot irrigation system at the Texas Agricultural Experiment Station, Halfway, Texas, 1986. (Bynum, E.D. 1986b)

Acaricide	Rate lb [AI]/A	Mean no. mites/plant ± S.D. (% Control) Pre-treatment	Days posttreatment 3	7	14
Within Alternate Row					
Comite (6.55EC)	0.5	506±210ab	150±119ab(57)	190±128a(26)	203±117a(-20)
Comite (6.55EC)	1.0	341±170bc	46±34c(81)	45±23b(74)	51±48b(55)
Comite (6.55EC)	1.7	341±170bc	80±80bc(85)	73±72b(82)	16±29bc(94)
Within Every Row					
Comite (6.55EC)	0.5	370±206bc	201±140a(21)	128±63a(32)	212±106a(-70)
Comite (6.55EC)	1.0	284±169c	30±24c(85)	17±46c(88)	40±36b(58)
Comite (6.55EC)	1.7	309±164bc	13±14d(94)	10±17c(94)	15±8c(86)
Within Row					
Check	-	305±179bc	209±88a	154±95a	103±66a
Above Row					
Comite (6.55EC)	0.5	199±166b	211±100ab(-38)	152±68a(-44)	252±109a(-165)
Comite (6.55EC)	1.0	141±94b	172±84b(-59)	111±58a(-49)	192±113ab(-186)
Comite (6.55EC)	1.7	381±261a	172±84b(-59)	158±119a(22)	164±114bc(10)
Check	-	241±158ab	185±91b	128±77a	115±69c

1/ Percent control, in parentheses, were adjusted by Henderson's formula.
2/ Means for either the Within or the Above row nozzle configuration, in each column, that are followed by the same letter are not significantly different according to Duncan's new multiple range test ($P < 0.05$).

A BELTWIDE LOOK AT CONSERVATION TILLAGE FOR COTTON

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Abstract

The adaptation of conservation tillage was revived in the late 1960's, but intensive research with cotton did not begin until the mid 1980's. Although data available on cotton grown in conservation-tillage systems are relatively limited, there are sufficient data to indicate that some form of conservation tillage will result in satisfactory yields on most soils. On most soils in the Cotton Belt, however, strict no tillage is not always successful. The major problems with conservation tillage appear to be 1) selecting the best conservation-tillage system for a particular soil, 2) weed control, and 3) mulch management. Insects and diseases do not appear to be more of a problem with conservation tillage than conventional tillage except with some types of mulches. It appears that more advances have been made in mulch management than in other problem areas. Most research, however,has been conducted in weed management, but due to site specific weed problems,it is almost impossible to prescribe a general weed control program that is effective over a wide area.

Introduction

The most recent surge in research on conservation tillage began in Kentucky and Virginia in the late 1960's and early 1970's. Research efforts spread into the Deep South in the mid-1970's, but at the time, soybean was the Golden Crop and most research efforts were directed toward soybean. Although some research was conducted with cotton grown in minimum-tillage systems in the late 1970's, intensive research efforts were not begun until the 1980's.

The primary purposes of conservation tillage are to protect the environment and maintain soil productivity. Although soil erosion is generally associated with gully-scarred fields, erosion also severely reduces yields, even in areas of a field where it's effects are not strikingly noticeable. In yield checks from over 50 farm fields in north Alabama from 1982-1984, Hajek and Williams (1987) found that moderately eroded soil produced only 76% as much cotton as slightly eroded soil. This yield difference (2424 and 1845 lb/acre of seed cotton for slightly and moderately eroded soils, respectively) can easily represent a difference between economic success and failure.

Some research has actually indicated more of a need for conservation tillage with cotton than for other crops. Mutchler et al. (1984) reported a 28-ton/acre soil loss with cotton grown in a conventional-tillage system. Average soil loss with previous crops of corn and soybeans grown on the same plots (Providence silt loam soil) was less than 10 tons/acre. Data from other locations (McDowell et al., 1984; Yoo et al, 1987) has not shown this magnitude of soil loss, but the amount lost is still cause for concern. McDowell et al., (1984) reported that the average soil loss over a 7-yr period from a 6 acre field of Sharkey silty clay was only 9 tons/acre. Contained in this sediment, however, was over 50 lb/acre of N and 37 lb/acre of P_2O_5, which represents a loss of over \$15/acre/year in fertilizer nutrients.

There is no doubt that conservation tillage is needed to protect the environment and maintain the productivity of the soil. Long term benefits, however, are investments for the future, and currently, short term survival is a more pressing problem. Researchers throughout the Cotton Belt have realized both needs and have attempted to develop conservation-tillage systems that would help control soil and water erosion, decrease production costs, and maintain productivity. Since researchers have reported that yields and fiber quality with conservation tillage can be as high or higher than yields with deep tillage (Brown and Whitwell, 1985b; Khalilian et al., 1983; Matocha and Bennett, 1984; Matocha et al., 1986; McConnell,1987; Mutchler et al., 1984; Stevens, 1987; and Stevens and Johnson, 1988), the primary concern is which form of conservation tillage will work best on a particular soil and environment and how should the system be managed.

As with other crops, there is a wide range of conservation-tillage systems that can be used in cotton production. These range from contour plowing to the elimination of all tillage operations (no tillage). Theoretically, strict no tillage is the most desirable system because it leaves the most surface residue and is the least costly. On some soils, such as the loess soils of west Tennessee, strict no tillage is consistently as effective as any production system (Tyler et al., 1988). On many soils, however, this system has not resulted in yields comparable to other systems (Baker, 1987; Brown et al., 1985; Grisso et al., 1984; McConnell, 1987; Mutchler and Greer, 1984; Smith and Varvil, 1982; Williford and Baker, 1985).

Poorer yields resulting from strict no tillage as compared to other conservation-tillage systems have been attributed to many factors. Among these are greater soil compaction, reduced plant stands, and greater pressure from insects, diseases, and weeds with no tillage than with other forms of conservation tillage.

Soil Compaction and In-row subsoiling

In areas where soil compaction can be severe in conservation-tillage systems, such as the coarse-textured soils of the Southeastern Coastal Plain, equipment has been designed to ameliorate this problem. This equipment utilizes row-spaced subsoiler shanks and fluted or rippled coulters to fracture root-restricting hardpans and surface till a 6- to 8-inch wide strip within the row ahead of the planter. These in-row subsoiler implements leave a significant amount of crop residue on the soil surface that results in improved water infiltration and decreased soil and water erosion (Elkins et al., 1983; Langdale et al. 1978). When used on compacted soils, these implements will usually result in yield increases (Table 1) (Grisso et al., 1984; Touchton et al., 1986a). Unfortunately, they are expensive tools and require large tractors for their operation. Economics dictates that these implements be used only in soils where root restricting hardpans are present. Their need is generally restricted to sandy Coastal Plain Soils, but even in the Coastal Plain it is sometimes impossible to determine whether or not they are needed because the response to these implements can vary from year to year on the exact same soil (Table 2). Recently, Vepraskas (1987) utilized rainfall histories and soil data (sand percentage and water retention of selected profiles) to calculate the probability of an economic yield response to subsoiling tobacco for 20 sites in North Carolina. This type of research could be used to take some of the guesswork out of recommending this practice for cotton on a site by site basis. Although yield responses are generally restricted to sandy Coastal Plain soils, Heilman (1987) reported that 3-yr average lint yields on a Harligen clay in Texas were 153 lb/acre higher with than without in-row chiseling.

Because of the expense required to operate in-row subsoilers, and the current inability to predict when their use might result in an economic yield response, research has been directed at finding ways to grow no-tillage crops without these subsoilers. Successful cropping systems have been identified for soybeans (Touchton et al., 1986b) which permit no-tillage planting without in-row subsoiling, even on soil with severe root-restricting hardpans. These systems however, which utilize deep tillage in the fall, are not showing much promise for cotton (Table 3). The need for in-row subsoiling at planting for grain sorghum grown on soils with root-restricting hardpans has been eliminated by subsoiling the row middles after crop emergence. This delayed subsoiling offers the grower flexibility when soil conditions are not conducive to subsoiling at planting, e.g., in a wet spring. Subsoiling row middles is also adaptable to sidedressing nitrogen applications (Reeves and Touchton, 1986). Cotton, however, is not responsive to this practice (Table 4). Cropping systems with bahiagrass (Table 5) have eliminated the adverse effects of hardpans on cotton, but these systems are not always feasible since bahiagrass is not a highly desirable forage crop in some areas and the soil has to be taken out of row crop production for at least 3 years (Long and Elkins, 1983). Band applications of fertilizer near the row have eliminated the need for in-row subsoiling for sorghum in some soils in Alabama, but it has not worked well for cotton (Touchton, 1987).

Williford (1987) reported that controlled traffic would eliminate the need for subsoiling on a Bosket fine sandy loam in Mississippi, but this research was not conducted in a no-tillage system. Research designed to completely eliminate the need for some form of deep tillage is continuing throughout the Cotton Belt, but it is doubtful that a single system will be developed that will work on all soils.

Stand Establishment

Several researchers (Brown et al., 1985; Gaylor, et al., 1984; Morrison et al., 1985; Williford and Baker, 1985) have indicated that cotton plant populations with conservation tillage are sometimes lower than with conventional tillage, and that as tillage intensity decreases and mulch residue increases, it becomes more difficult to establish stands (Table 6) (Brown et al., 1985; Dumas, 1980; Grisso et al, 1984).

Poorer plant stands as the amount of tillage decreases have been attributed to soil temperature (Grisso et al., 1985), insects (Gaylor et al., 1984), and diseases (Rickerl et al., 1986). Temperatures of untilled soils, especially when mulches are present, tend to be several degrees cooler than clean tilled soils. Since a few degrees difference in temperature can make a big difference in seed germination and survival, planting too early in untilled soils can result in poor stands. Cotton planted into a winter annual legume is especially subject to stand reductions (Grisso et al.,1985; Rickerl et al., 1986). This effect has been attributed to increased levels of soilborne pathogens (Rickerl, 1986), un-ionized ammonia, and organic toxins (Megie et al., 1967). Cotton has the ability, within limits, to compensate for reductions in plant populations. Thus, reduced stands with conservation tillage do not always result in lower yields. In some situations, however, researchers have reported that yield reductions with conservation tilllage were due to lower plant population (Table 6) (Brown and Whitwell, 1985b; Grisso et al., 1984; Morrison et al., 1985).

Some research projects have been established for the purpose of identifying methods of improving germination and seedling survival in conservation-tillage systems. Rickerl et al., (1986) used combinations of N sources and fungicides at planting and had some success in improving plant stands. The only consistent result among years was that fungicides were generally needed, but their use did not always result in stands as high in no tillage as in tilled systems (Table 7). Results from other studies (Rickerl, 1986) have indicated that the best method of insuring a stand with no tillage is to use some type of mechanical attachments to clear crop residue away from the row at planting. Since germination is highly dependent on temperature, it would probably be best to base seeding rates on warm and cool germination percentages as well as the 5-day heat unit forecast as suggested by Kerby et al. (1987).

Fertilizers

Theoretically, fertilizer requirements should be the same for all tillage systems, and a sound fertility system which is based on soil test recommendations should be followed. Over the years, however, many researchers have noted that crops planted in some untilled soils will grow slower and mature later than those planted in similar tilled soils. Initial studies with corn and grain sorghum (Touchton and Hargrove, 1983; Touchton and Karim, 1986) indicated that this slower growth was due to an inadequate supply of nutrients, even though the soils were testing high in residual nutrients. The slower plant growth was attributed to wetter, cooler, and more compacted soils in the untilled than tilled soils. These conditions result not only in a reduced rate of conversion of nutrients from the plant unavailable to plant available forms, but also in poorer root growth in untilled soils which prevent the roots from reaching the plant available nutrients. As with other crops (Touchton and Hargrove,1983; Touchton and Karim, 1986; Touchton and Rickerl, 1986), research data (Touchton et al., 1986a) have indicated that band applications of fertilizer at planting (starter fertilizer) can alleviate these problems, resulting in yields with untilled soils being comparable or higher than with tilled soils (Table 8). It should be noted, however, that starter fertilizers do not always improve cotton yields (Matocha et al., 1986). In addition to improving yields, starter fertilizer can also enhance maturity (Table 9). The use of starter fertilizers can be an integral component of management systems for short-season cotton and once-over harvesting and could prove exceptionally important for late planted cotton.

There have been a sufficient number of studies conducted to indicate that starter fertilizers are probably needed for no-tillage cotton production on most soils, but there are currently not enough data to determine which nutrients are needed, what rates should be used, or how they should be applied. Studies conducted in Tennessee (Howard, 1987) indicate that N alone may be adequate, but those conducted in Alabama (Touchton et al., 1986a) and currently being conducted in Mississippi (Funderburg, 1987) indicate that P is also needed.

Shallow incorporation of starter fertilizers is generally recommended, and studies with some crops have shown that the incorporated fertilizers are more effective than surface-applied starters (Touchton and Hargrove, 1983). In no tillage systems, however, it is difficult to incorporate these fertilizers unless planting implements with in-row subsoilers or chisels are being used. If subsoilers are being used, liquid fertilizers can be placed deep in the subsoil track by welding a tube behind the subsoil shank (Touchton and Rickerl, 1985). If dry fertilizers are being used, the fertilizers can be allowed to free-fall into the subsoil track, but this freefall system does not work well for liquids. Fertilizers should not be placed in direct contact with seed because they can have an adverse effect on plant stand (Matocha et al., 1986). Research currently being conducted in Mississippi has indicated that narrow bands of N-P solutions sprayed directly on top of the row is an acceptable method for cotton (Funderburg, 1987), but data available on surface applications are currently more limited than the other methods.

Cover Crops

Cover crop selection and management are critical in conservation-tillage systems. Although many advantages are listed for cover crops, there are also associated disadvantages which are seldom mentioned. Cover crops can extract large amounts of soil water which can adversely affect yield of summer crops, especially in years with unusually dry springs (Brown et al, 1985; Grisso et al., 1985); can result in poor plant stands (Brown et al., 1985; Dumas, 1980; Touchton et al., 1984; Rickerl et al., 1986; Grisso et al., 1985); can provide a favorable environment for insects (Gaylor et al., 1984) and diseases (Rickerl et al., 1986); can delay maturity (Table 10) (Brown et al., 1985; Gaylor et al., 1984; Stevens and Johnson, 1988); and can result in added expenses that cannot be recovered without substantial yield increases in cotton yields. If a cover crop is used, it is highly advisable to kill the cover crop several weeks prior to the intended planting date (Grisso et al., 1984). Killing the cover crop ahead of planting will prevent excessive soil water extraction by the cover crop and will considerably improve the chances of obtaining adequate plant stands and plant growth. Sometimes winter cover crops are difficult to kill (Brown and Whitwell, 1985; Stevens, 1987), and spraying several weeks ahead of planting will give sufficient time to apply more herbicides if needed.

Currently, the disadvantages associated with cover crops suggest that the best approach is not to use them except on soils that are highly susceptible to wind and water erosion, or when there are alternative uses for them. One alternative, *i.e.*, double cropping wheat with cotton, has been studied in Arkansas (Smith and Varvil, 1982) and Georgia (Baker, 1987). The development of early maturing cotton and wheat cultivars has made this system feasible in the more southern regions of the Cotton Belt. Full-season cotton yielded 28 and 50% greater than double cropped cotton in the Georgia and Arkansas studies, respectively. Effects of tillage systems in these studies varied with climatic conditions and soil types. Market prices and yield levels of the two crops would determine if double cropping is an economic alternative to full-season cotton. Other alternative uses for cover crops include winter grazing, silage production, and N production.

The use of legume cover crops as N sources for subsequent cotton crops has been studied by several researchers (Brown et al., 1985; Dumas, 1980; Touchton et al., 1984; Tyler et al., 1987; Rickerl, 1986). Various clovers and vetches have been the most widely used legumes in these studies. In some situations these legumes eliminated the need for N fertilizer (Table 11), but in others, some N fertilizer was needed for top cotton yields (Touchton et al., 1984; Tyler et al., 1986). Whether or not N fertilizer is needed depends on many factors, such as the amount of N produced by the legume and the environmental conditions that affect the release of N from the decaying legume tissue. Since a legume crop does not always provide adequate N for cotton when the crop needs it, even when adequate N is present in the legume tissue (Brown et al., 1985; Touchton et al., 1984), a general recommendation would be to apply about 30 lb N/acre at planting to cotton planted into a winter legume mulch. Applying high rates of N to cotton planted in winter legumes can result in yield reductions (Table 11) (Touchton et al., 1984; Tyler et al., 1986).

Many winter legumes are capable of reseeding themselves each year. This is an excellent method for greatly reducing cover crop costs and providing high amounts of N to the summer crop. Reseeded legumes are similar to interseeded legumes in that they generally become established earlier than planted legumes and as a result produce more N than the planted legumes (Brown et al., 1985; Touchton et al., 1984). In addition, self-seeded legumes are generally more winter hardy than planted legumes. Seed production, however, must occur prior to the optimum planting date for cotton, which greatly limits the selection of legumes that can be used. Winter-kill is a potential problem for winter annual legumes and the economic risk involved with planting them is always a concern. Some research has been conducted to identify methods of establishing legumes in the more risky northern areas of the Cotton Belt. In north Alabama (Brown et al., 1985), crimson clover planted after cotton was harvested winter-killed in 2 of 3 years, but clover interseeded prior to defoliation survived and thrived each year. Hairy vetch, which is more winter-hardy than crimson clover, produced adequate stands with both late planting and interseeding each year.

It is probably more critical to kill winter legumes than non-legume cover crops in advance of planting. As with other types of cover crops, winter legumes can deplete soil moisture, and in addition, they are more likely to provide a favorable environment for insect and disease organisms (Gaylor et al., 1984; Rickerl et al., 1986). The disadvantages of using winter-annual legumes as cover crops should be tempered by the frequently overlooked advantage they demonstrate in slowly improving soil physical conditions, which in turn steadily improves soil productivity (Touchton et al., 1984; Bruce et al., 1987).

Weeds

Since research has shown that, with proper management, some form of conservation tillage will result in yields equal to or higher than conventional tillage on almost any soil, the expense of weed control is probably the single most important factor which will determine the most economical system. During the past few years, several researchers have developed herbicide programs for controlling weeds in conservation-tillage systems (Brown and Whitwell, 1985a and 1985b; Brown et al., 1987; Johnson et al., 1983). In addition to the few published studies, extensive data from unpublished studies are available in almost every state in the Cotton Belt. Weed control programs developed from these studies are generally weed and sometimes site specific, and the many possibilities are too numerous to cover in this paper. It is important to remember that the presence of some troublesome weeds can definitely restrict the use of conservation tillage, and that the cost of herbicides, tillage, and combinations must be carefully considered. In addition, there is a strong tendency in some areas for weed problems to become more intense as years of conservation tillage accumulate and more intense weed management programs may be needed as the duration of conservation tillage increases (Brown and Whitwell, 1985).

Insects and Diseases

With the possible exception of cutworms in an isolated situation (Gaylor et al., 1984), there has not been any strong evidence that insect damage will be more severe in cotton grown in untilled than tilled soils (Gaylor et al., 1984; Roach and Culp, 1984; Roach 1981). Gaylor et al. (1984) recommended that cotton be scouted closely for cutworm when grown with conservation tillage. There is strong evidence (Table 12) that Rhizoctonia can be more severe in no-tillage systems that utilize winter annual legumes than in conventional-tillage systems (Rickerl, 1986; Rickerl et al., 1986). The problem can be eliminated by in-furrow fungicides in some years. It appears, however, that killing the legumes several weeks prior to planting and/or using planter attachments that will move the legume tissue away from the row will give the most reliable control.

Summary and Conclusions

There is fairly strong evidence that cotton can be successfully grown in conservation-tillage systems on most any soil in the Cotton Belt. There are, however, many forms of conservation tillage, and unfortunately, the system that works best on one soil may not be successful on other soils.

Compared to corn and soybean, the amount of data available on conservation-tillage systems for cotton is limited. Fortunately, several research projects have recently been completed and many are currently in progress. Information from these studies which can be helpful in selecting and managing conservation-tillage systems for cotton includes:

Soil Compaction: Soil compaction is generally the primary factor that determines whether strict no tillage or some form of modified tillage has to be used. On some soils, compaction is more severe with conservation tillage than conventional tillage, and some soils have root restricting hardpans several inches below the soil surface. If surface soil compaction is a problem, shallow chiseling may be needed. If root restricting hardpans are present, in-row subsoilers are almost always essential tools. Unfortunately, these soils can be difficult to identify, and a reliable system for identifying these problem soils has not been developed.

Soil Fertility and Fertilizers: Except for the use of starter fertilizers, there is no strong evidence to indicate a need for varying basic fertility practices with tillage systems. Most available data indicates early-season growth and yields can be improved with the use of N and P starter fertilizers at planting. Shallow incorporation is probably the best method of application, but favorable yield responses have been obtained with surface applications. In some tests, the use of starter fertilizers was the primary factor responsible for higher yields with conservation than conventional tillage. In addition,the use of starter fertilizers can negate the delayed maturity commonly associated with conservation tillage.

Cover Crops: Disadvantages associated with cover crops can exceed the advantages. They can deplete soil moisture, enhance weed, insect, and disease problems, and result in unrecoverable expenses. Because of the disadvantages associated with cover crops, it is probably best not to plant cover crops except on soils highly susceptible to water and wind erosion or unless there is an alternate use for the cover crop. Alternate uses would include planting winter legumes as a N source for cotton. If legumes are planted, they should be killed several weeks in advance of planting, and/or planting units should be rigged so that the legume tissue will be pushed away from the row. Even when legume yields are high, approximately 30 lb/acre N should be applied at planting.

Weeds: The expense of weed control is probably the single most important factor which will determine the most economical tillage system. Since weed problems are generally site specific, a general weed control program cannot be recommended. However, the cost of herbicides, tillage, and combinations must be carefully considered.

Insects and Disease: Although it is generally assumed that conservation tillage will result in additional insect and disease problems, additional problems have not been commonly noted with cotton. There have been some situations where cutworms were a problem in clover mulches. Rhizoctonia can be a severe problem when cotton is planted into a recently killed legume mulch. It appears that this problem can be avoided by killing the mulch a few weeks in advance of planting and by using planting equipment that will move the legume tissue away from the cotton row.

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Table 1. Seed cotton yield (2-yr average) as affected by in-row subsoiling on a Norfolk sandy loam soil.[1]

In-row subsoiled	Planting date: Early	Late
	Yield, lb/acre	
No	1450	1220
Yes	1650	1300

[1] Grisso et al., 1984.

Table 2. Effect of starter fertilizer and in-row subsoiling on yield of cotton grown in conventional and conservation tillage systems.[1]

Starter[2] fertilizer	In-row Subsoiled	1983 Till	1983 No-till	1984 Till	1984 No-till
		seed cotton, lb/acre			
No	No	1790	1840	1960	1600
	Yes	1700	1780	1690	1800
Yes	No	1980	2220	2370	2160
	yes	2070	2700	1870	2160

[1] J. T. Touchton, unpublished data, Auburn University.
[2] Starter fertilizer was 100 lb/acre of 22-20-3.

Table 3. The effect of tillage prior to planting rye on yield of subsoiled and non-subsoiled cotton grown on a Lucedale fsl.[1]

Tillage for rye	In-row subsoiling for cotton	
	No	yes
	------ Yield, lb/acre -------	
None	2660	3090
Disk	2810	3360
Chisel	2830	3020
Turn	2770	3310

[1] J. T. Touchton, unpublished data, Auburn University

Table. 4. Effect of previous crop tillage, in-row subsoiling for cotton and sorghum, and between row subsoiling after emergence on yields of cotton and sorghum grown on a Benndale fsl.[1]

Subsoiling		Tillage prior to planting winter crop					
In-row	Between row	None	Disk	Deep	None	Disk	Deep
		-sorghum, bu/acre-			-cotton,[2] lb/acre-		
Yes	No	74	65	72	3080	3360	3160
	Yes	64	79	72	2870	2950	3050
No	No	63	65	66	2670	2810	2800
	Yes	78	78	80	2510	2610	2840

[1] J. T. Touchton, unpublished data, Auburn University.
[2] Seed cotton.

Table 5. Six-yr average seed cotton yields as affected by bahiagrass sod.[1]

Previous crop	Years in sod	Cotton yield
		lb/acre
Row crops	0	1320
Bahiagrass	3	2370
Bahiagrass	4	2540
Bahiagrass	5	3160

[1] Long and Elkins, 1983.

Table 6. Final cotton stand and yield as affected by cover crop and kill date for the cover crop.[1]

Cover crop	weeks before killing cover crop			
	2	4	2	4
	--- plants/ft ---		- yield, lb/acre -	
No cover	4.0	4.4	1250	1360
Wheat	3.7	4.0	1720	1550
Vetch	3.1	3.0	1220	1130
Clover	1.7	2.0	870	1290

[1] Grisso et al., 1984.

Table 7. Cotton population as affected by tillage, cover crop, and fungicides.[1]

Tilled	Fungicide	Decatur sil		Norfolk sl	
		Legume	Fallow	Legume	Fallow
		------------ 1,000/acre		---------	
Yes	Terrachlor	92	98	81	92
No	None	30	92	19	71
No	Terrachlor	83	99	66	90

[1] Rickerl et al., 1986.

Table 8. Seed cotton yield as affected by tillage and starter fertilizer.[1]

Starter fertilizer[2]	Tillage	
	Conventional	Conservation
$N - P_2O_5$	------- yield, lb/acre	--------
No - Yes	3530	3300
Yes - No	3730	3630
Yes - Yes	3700	3700

[1] Touchton et al., 1986a.
[2] N and P_2O_5 rates were 23 lb/acre.

Table 9. Percentage of cotton bolls opened on 15 Oct. as affected by tillage and starter fertilizer.[1]

Starter fertilizer	Tillage and subsoiling			
	Tilled		No-till	
	yes	No	No	Yes
	---------- opened bolls, %		-----------	
No	18	10	10	3
Yes	60	56	58	48

[1] Touchton, 1987.

Table 10. Percentage of cotton picked at first harvest (3-year average) as affected by winter crop and spring tillage.[1]

Winter crop	Spring tillage	
	No-till	Disk
	------ first harvest, %	-------
Clover	64.9	84.4
Vetch	63.3	81.4
Rye	79.1	77.4
Fallow	82.9	85.5

[1] Brown et al., 1985.

Table 11. Cotton yields as affected by winter cover crop and applied N.[1]

Winter crop	Year	Applied N, lb/acre		
		0	30	60
		-------- lint, lb/acre		----------
Fallow	1981	460	540	550
	1982	590	800	890
Clover	1981	640	540	470
	1982	955	900	810
Vetch	1981	670	650	650
	1982	820	990	960

[1] Touchton, et al., 1984.

Table 12. *Rhizoctonia* infestation in cotton as affected by cover crops.[1]

Soil	Cover crop	Disease infestation			
		Severe	Moderate	Slight	None
		---------------	%	-----------	
Decatur	Legume	9	57	33	0
	Fallow	3	27	67	4
Norfolk	Legume	0	84	15	0
	Fallow	1	34	51	14

[1] Rickerl et al., 1986.

MY EXPERIENCE WITH CONSERVATION TILLAGE

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Key Words: Conservation tillage, Soil erosion, Conserve resources, New methods, Reduced tillage, Rotation, Chemical weed control, Chiselling in fertilizer

Abstract

Experience with conservation tillage has shown benefits through higher yields, better water retention, conserving soil, and earlier maturity of cotton. Also, the number of hours of plowing time is less.

Introduction

It has been said, "If the wind is not blowing, there is one thing for certain. You are not in West Texas."

Farming in an area of West Texas which has little rainfall but high winds, it is a significant problem to protect young cotton from soil erosion and strong winds. The objective of reducing soil erosion is parallel to the conserving of water at the same time.

In today's economy, it is a gamble to do very much experimenting with new methods. However, in today's economy it is imperative to find new methods which conserve resources and profits. Yesterday's methods brought us to today but will not take us far into tomorrow. New methods must be created for future conservation and farming.

My Experience

Reduced tillage produces yields which have exceeded conventional methods. Cotton matures one and one-half to two weeks sooner, and less time is spent in the actual farming procedures than in other methods.

The system provides cover on two-thirds of the land at all times. It is a basic rotation of cotton, fallow, and wheat on nonirrigated land and a rotation of cotton and wheat on irrigated land. When the wheat is harvested, the stubble is left standing throughout the summer, fall, and winter. By chemically controlling weed growth and chiselling in fertilizer, the cotton can be planted in the wheat residue. The residue serves to completely protect the young cotton from strong winds and drastically increases water retention and prevents runoff.

Following a successful cotton harvest, soil is listed toward the cotton stalks which are left standing.